World Journal of Advanced Research and Reviews
eISSN: 2581-9615 CODEN (USA): WJARAI
Cross Ref DOI: 10.30574/wjarr
Journal homepage: https://wjarr.com/

(RESEARCH ARTICLE)

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Relationship between body mass index and stage at breast cancer diagnosis

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World Journal of Advanced Research and Reviews, 2025, 27(01), 2401-2406

Publication history: Received on 09 June 2025; revised on 14 July 2025; accepted on 17 July 2025

Article DOI: https://doi.org/10.30574/wjarr.2025.27.1.2693

Abstract

Background: The relationship between Body Mass Index (BMI) and risk of developing breast cancer is very well researched. However, there is a relative dearth of studies on the relationship between BMI and the stage of breast cancer at diagnosis. This study aims to explore this relationship.

Aims/objectives: The aim of this study was to evaluate if there is any relationship between BMI and the stage of breast cancer at diagnosis among women attending the Breast Clinic of a tertiary health facility in Nigeria.

Methods: This was a retrospective study (n=110) conducted at Nnamdi Azikiwe University Teaching Hospital, Anambra State. The BMI categories of participants and the clinicopathological stages of their tumours were obtained from the medical files of consenting patients who met the inclusion criteria. The data was analysed using the Statistical Programme for the Social Sciences (SPSS) Version 20.0. Logistic regression was used to draw association between stages of cancer at diagnosis and BMI categories.

Results: The mean BMI(SD) was 28.09(6.35)kg/m^2. There was a moderate, statistically significant positive correlation between being overweight/obese and having a late stage at diagnosis of breast cancer (OR=2.36, 95% C.I.: 1.06-5.27; P=0.03). After controlling for age, occupation and highest educational attainment, this association was slightly stronger (O.R=3.29, 95% C.I: 1.31-9.10).

Conclusion: There is a need to place particular emphasis on very rigorous breast self-examination in women with high BMI as they are likely to present with more advanced tumours.

Keywords: Breast cancer; Stage; BMI; Obesity; Overweight

1. Introduction

Body Mass Index (BMI) is one of the many metrics used to assess if an individual is underweight, overweight, obese or morbidly obese. The United States National Institute for Health (NIH) has defined being overweight as having a BMI between 25-29.9 and obesity as a BMI of 30.0 or more (1). It is generally agreed that obesity is an independent risk factor for the development of breast cancer. This association is unequivocal in post-menopausal women (2-8), but more ambiguous in pre-menopausal women, with some studies suggesting a direct relationship (3,9,10) while some suggest an inverse relationship (11-14).

The relationship between body mass/obesity and stage at breast cancer diagnosis for women of all age groups (postmenopausal or premenopausal) is even more blurred, firstly because of a relative paucity of such studies, secondly because of some ambiguity in the few studies already conducted and thirdly because the picture seems to be complicated by the method of detection of the breast cancer in the first instance (15). Howson et al noticed in their study

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that being overweight or obese was unassociated with tumor stage, tumor size or extent of axillary node disease at the time of diagnosis (16), similar to findings in some other studies (17,18). However, an overwhelming majority of studies find that obesity is positively related to more advanced disease at diagnosis (15,19-27). There is also some discrepancy as to what component(s) of the staging i.e tumor size or lymph node involvement (or both) has some correlation with obesity; one study (13) found obesity to relate only to lymph node involvement, but not tumour size at diagnosis. Other studies (12,21,27-29) report that tumour size, but not lymph node involvement have a correlation with obesity, while others (19,30,31) found obesity being linked to both large tumour size and lymph node involvement.

It had long been thought that the significantly later presentation among black breast cancer patients in the United States compared to their white counterparts was occasioned by cultural and socioeconomic factors but one study suggests it could be due to a difference in the relative prevalence of severe obesity in both racial groups with black women having a noticeably higher incidence of severe obesity than white women and with severe obesity being associated with later stages at diagnosis (19). Some studies have also shown a relationship between patients with larger breasts and later stages at presentation, suggesting that the delayed presentation may be due to some difficulty in recognising the existence of the lump in the first place (20).

Aim of study

Because women with higher BMI may generally have larger and denser breasts, it may be more difficult to notice, by palpation or mammography, appearance of any new lumps, delaying presentation and thereby leading to more advanced diseases at presentation. Furthermore, obesity may impart a higher degree of invasiveness to breast cancers. The study was aimed at delineating the relationship between BMI categories and the stage of breast cancer at diagnosis among women in a healthcare centre in South-Eastern Nigeria.

2. Methodology

This study was carried out in a government-owned tertiary health facility in Nigeria. Ethical clearance was obtained from the Nnamdi Azikiwe University Teaching Hospital Ethical Committee. It was a retrospective study using information from the medical files of 110 consecutive patients seen at the Breast Clinic of the facility from January 2022 to December 2023. The inclusion criteria were all consenting females above 25 years of age who had diagnoses of breast cancer and who were being managed at the Breast Clinic in the hospital. The participants were contacted using information in their medical notes before collection of data and their consent was gotten. Patients who were already cachectic at diagnosis or who did not give their consent (or could not be contacted) were excluded from the study.

Patients' weights and heights are some of the anthropometric measurements routinely taken during visits to the Breast Clinic. The body weights are obtained by trained clinic assistants using a weighing scale (OMRON HBF-510 W) and heights are obtained (to the nearest cm) using a rigid measuring tape. The BMI was calculated as: Body Weight(kg) ÷ height(m^2) and the value was approximated to two decimal places. BMI used in this case was the BMI at the point of histological/clinical diagnosis and staging. A subject was regarded as having a normal weight if their BMI was between 18.5-24.9kg/m^2, as being overweight if their BMI was between 25.0-29.9kg/m^2 and as being obese if their BMI was equal to or greater than 30.0kg/m^2.

Tumours of Stages 0, 1A, 1B and 2A were classed as "early stage" while those of Stages 2B, 3A, 3B, 3C and 4 were classed as "late stage".

The Statistical Program for the Social Sciences (SPSS) version 20.0 was used for data analysis.

3. Results

The modal age range of participants was 51-75 years, with those in this age range accounting for 45.5% of the total participants, followed closely by those in the age range 26-50 years who accounted for 42.7% of total participants. The mean participant age (SD) was 54.06(13.09) years. Just over half of the subjects had early stage tumours (58 participants, 52.7%) while the rest had late stage tumours. The mean BMI(SD) was 28.09(6.35)kg/m^2. A significant majority (55.5%) of the participants were traders due to the socioeconomic characteristics of the region where the study was carried out. 37.3% of participants attained a tertiary level of education. The sociodemographic characteristics of the participants are highlighted in Table 1.

There was a moderate, statistically significant positive correlation between being overweight/obese and having a late stage at diagnosis of breast cancer (OR=2.36, 95% C.I.: 1.06-

5.27; P=0.03). After controlling for age, occupation and highest educational attainment, this relationship was even stronger (O.R=3.26, 95% C.I: 1.31-9.10). (Tables 2 and 3).

4. Discussion

Our findings show that older women have a higher risk of breast cancer development, corroborating findings from prevalence studies on age-related risk (32,33). Generally, breast cancer incidence has been noted to be positively positively correlated with advanced ages with a peak at ages greater than 70 years (34, 35) . Liu et al. (36) in a dose-response meta-analysis evaluating the relationship between obesity and breast cancer recorded a 2% increase in the risk of breast cancer for every 5 unit rise in the BMI in pre-menopausal women.

Paradoxically, some studies suggest that a higher BMI may be protective of breast cancer in pre-menopausal women (37). The higher risk of breast cancer in obese post-menopausal women has been ascribed to the significantly higher activity of aromatase in this cohort, particularly in adipose tissue, where it converts androgens into estrogen (38). Since estrogen is mitogenic for mammary cells, the increase in estrogen levels may drive them to undertake repeated rounds of cell division, increasing breast cancer risk (37).

Apart from the risk on the development of breast cancer, BMI levels have also been noted to affect disease outcome in women diagnosed with breast cancer. Obesity has been shown to correlate with larger primary tumour sizes and increased invasiveness, ultimately worsening the prognosis in this cohort of patients (39,40). Once again, these may be due to higher levels of estrogen from adipose tissue (41). A further layer of complexity may be due to the size of the pre-disease breasts. Because overweight and obese women generally have larger breasts, it may be more difficult for them and/or their partners to notice small breast lumps, leading to their presentation at later stages (42,43).

5. Conclusion

Early diagnosis of breast cancer is important as it enables prompt initiation of care. This study establishes that overweight/obese patients are at risk of presenting at more advanced stages of breast cancer compared to their normal weight counterparts. Policies that promote weight loss through lifestyle modification may reduce the overall risk of breast cancer development in all women. Routine breast self- examination remains a simple, cheap and invaluable method of screening for lumps and other changes in the breasts. There may be a need to educate women with higher BMI levels (and larger breasts) on the need to be extra-rigorous in their breast self-examination to enable earlier detection and possibly improve prognosis.

More studies are very much needed to strengthen or refute this relationship delineated here. Importantly, maybe new studies can focus on investigating any relationships between actual size/weight of pre-disease or unaffected breasts and stage at breast cancer diagnosis; such studies may more accurately delineate he relationship between breast size and stage at diagnosis.

Table 1 Characteristics of study subjects

Characteristics		**Frequency**	**Percentage**
Age(years)	26-50	47	42.7
	51-75	50	45.5
	>=76	13	11.8
	Mean	54.06±13.09	
Occupation	Dependent	17	15.5
	Trader	61	55.5
	Artisan	5	4.5
	Civil servant	19	17.3

	Retired	4	3.6
	Student	4	3.6
Education	No formal education	5	4.5
	Primary	33	30
	Secondary	31	28.2
	Tertiary	41	37.3
Stage	Early	58	52.7
	Late	52	47.3
BMI (kg/m2)	Underweight	0	0.00
	Healthy weight	41	37.30
	Overweight	22	20.00
	Obese	47	42.70
	Mean	28.09±6.35	

Table 2 Relationship between body mass index (BMI) and stage at breast cancer diagnosis

BMI	**Stage**		**Total n (%)**	**X^2**	**p-value**
	Early n (%)	**Late n (%)**			
Overweight/Obese	31 (44.9)	38 (55.1)	69 (62.7**)**	4.518	0.034
Normal weight	27 (65.9)	14 (34.1)	41 (37.3)		

There is a positive significant relationship between high body mass index (overweight/obesity) and later stage at breast cancer diagnosis.; Note: p-value less than 0.05 was regarded as statistically significant.

Table 3 Odd Ratio and 95% CI for being diagnosed with late stage in overweight/obese women compared with normal weight women

BMI	**B**	**S.E.**	**Wald**	**Df**	**Sig.**	**Unadjusted OR (95 % CI)**	**Adjusted OR (95 % CI)**
Overweight/Obese	0.86	0.409	4.432	10	0.035	2.364 (1.06-5.27)	3.29(1.31-9.10)
Normal weight	R	r	R				

Adjusted odd ratio = adjusted for age, occupation, education level.

Women who were overweight/obese were more likely to be diagnosed with late stage of cancer (OR=2.36, 95% C.I.: 1.06-5.27; P=0.03) than women of normal weight. Additionally, after controlling for age, occupation and educational level, overweight/obese women had significantly higher odds of late stage at diagnosis when compared with women of normal weight.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of ethical approval

This study was conducted in compliance with the relevant ethical standards in the Declaration of Helsinki. Ethical clearance was obtained from the Nnamdi Azikiwe University Teaching Hospital Ethical Committee.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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